Journal of Forensic and Legal Medicine 19 (2012) 18–21

Contents lists available at SciVerse ScienceDirect

Journal of Forensic and Legal Medicine

journal homepage: www.elsevier.com/locate/jflm

Original communication

Relation between fingerprints and different blood groups

I. Noor Eldin Fayrouz MD, Asst. Professor [a], Noor Farida MD, HOD [b], A.H. Irshad PhD, Asst. Professor [c,*]

[a] Forensic Medicine and Toxicology, Menofiya University, Egypt
[b] GMC, Forensic Medicine and Toxicology, Kashmir, India
[c] Dept. of Biochemistry, Al-Jabal Al-Gharbi University, Zawia, Libya

ARTICLE INFO

Article history:
Received 8 April 2011
Accepted 13 September 2011
Available online 20 October 2011

Keywords:
Biometric
Blood groups
Dactylography
Identification

ABSTRACT

Fingerprint is one of the oldest, reliable and mature biometric technologies and is considered one of the best, cheapest and legitimate proofs of identification. A correlation between physical characteristics like fingerprints and blood group was demonstrated in previous studies. This study was carried out in 2010 on 305 Libyan medical students of Al-Jabal Al-Gharbi, University, Zawia, Libya and were selected randomly having different ABO blood groups, with the objective to a) Study distribution of fingerprint pattern among the subjects having different ABO and Rh blood group b) Correlate any relation between their characters and blood group. The data from the study showed that male: female ratio was 1.2:1. Majority of subjects (48.9%) in this study were of blood group O followed by blood group A (33.1%), B (12.8%) and AB (5.2%). Rh-positive cases constitute about 87.2% of all studied cases. The general distribution of pattern of finger showed high frequency of Loops registering 50.5%; followed by whorls (35.1%) and arches (14.4%). In Rh+ve cases of blood group A and O loops incidences were the highest (52% and 54.3% respectively) then whorls (33.4% and 30.6% respectively), while in blood group B whorls were predominance in both Rh+ve and Rh−ve cases. In all blood groups there were high frequency of loops in thumb, index and little fingers.

1. Introduction

A reliable personal identification is critical in the subject of forensics as is faced with many situations like civil, criminal, commercial and latest in financial transaction frauds, where the question of identification becomes a matter of paramount importance. Although human beings have been using fingerprints as a means of identification for a long time but in this study we have made an effort to take step further to "study a relationship between pattern of fingerprint and ABO Rh blood group", so that one can get an idea about the expected blood group from the study of fingerprint pattern and vice versa. A person can be identified based on a) A Person's possession (something that he possess) for example key to physical access to a building, possessing pieces of information example "login access" to a system.

b) Positive identification is by physical characters like fingerprints (dactylography), behavioral/physiological characteristics like voice, signature etc called "BIOMETRICS". Since biological characteristics like fingerprints and blood groups cannot be forgotten and replicated like keys, password etc. hence are considered more reliable, authentic and credible in forensic sciences. Besides study of "blood group" prevalence in itself is not only important for transfusion medicine but also for organ transplantation and genetic research, prediction of certain malignancies/diseases for certain blood groups[1] as well as in evolution studies that helps scientists to understand the place human being occupy in evolution's branching tree.[2,3]

An association has also been found between distribution of finger-print pattern and blood groups. In a study by Hahne[4] asserted that blood group "O" is associated with more loops and less whorls than blood group A. Herch,[2] found high frequency loops in blood group A, Recently Gowda and Rao[3] reported high frequency of loops with moderate whorls and low arches in the individuals of A, B and O blood group, they also found greater number of loops Rh positive and whorls in Rh negative subjects in their study. The objective of our study was to ascertain trend of fingerprints and its relation to ABO and Rh blood groups, in a totally different community and continent.

2. Fingerprint as a biometric

A persons fingerprint is permanent even before they are born, around 6–8 weeks after conception the volar pads form, (ball like structures that make up the contour of the fetal hand). By 10–12 weeks after conception the volar pads begin to recede, around 13th

* Corresponding author.
E-mail address: Irshad_libya@yahoo.com (A.H. Irshad).

1752-928X/$ – see front matter © 2011 Elsevier Ltd and Faculty of Forensic and Legal Medicine. All rights reserved.
doi:10.1016/j.jflm.2011.09.004

week skin ridges appear and take the shape of the receding volar pads, lastly around the 21st week after conception the fingerprint pattern are completed.[6] The volar skin is composed of two layers, the outer epidermis and inner dermis.[7] The permanence principle is due to three structural elements, a) The adherence of the epidermal cells to each other, b)The basal cell layer of the epidermis and its attachment to the basement membrane, c) The attachment of the basement membrane to the dermis.[8] Fingerprints of even identical twins are different.[9]

3. History of fingerprints

Modern fingerprint matching techniques were initiated in the 16th century. It was Henry Fauld in 1880 who first scientifically suggested the individuality and uniqueness of fingerprint. Herschel[8] contributed to the foundation of modern fingerprinting identification. In the 19th century Sir Francis Galton[9] conducted extensive studies and classified the types of fingerprints depending upon primary pattern as loops, whorls and arches. It was Cummins[10] who coined the term "Dermatoglyphics (derma = skin, glyphics = curves), to dermal ridge configurations on the digits, of palms and sole and also showed that ridge pattern are determined partly by heredity or environmental influence which produce stress and tension in their growth during fetal life. Though in later life some role of diet and occupation has also been documented. An important advance in fingerprinting identification was made in 1899 by Edward Henry who established "Henry system of Classification", an elaborate method of indexing fingerprint, very much facilitating the performing of manual fingerprinting. It was in early 20th century that fingerprinting was accepted formally as a "valid personal" identification method by "law enforcement agencies" and became a standard procedure in forensics.[11]

4. Methods and methodology

This study was carried out in 2010 on 305 Libyan medical students of Al-Jabal Al-Gharbi University, Zawia, Libya. Students were randomly selected and their fingerprints were studied.

A Performa was prepared on a durable white paper divided into two, marked as right and left, and each further into five columns (marked as thumb, index, middle, ring and little), rubber stamp ink pads were used for smearing the balls of each finger (blue was found to better as compared to green), imprints were taken of each, (repeated thrice of each finger for better evaluation), pattern of fingerprint were observed by powerful hand lens and recorded. Note was made of the sex, age, ABO and Rh blood group for studying the relationship between types of fingerprints and relation to ABO and Rh blood type.

4.1. Statistical analysis

The data were recorded, tabulated and statistically analyzed using SPSS statistical program. Data expressed as number and percentage and analyzed by X2, level of significance was set as P value < 0.05.

Table 1
Distribution of cases according to sex and blood groups ($n = 305$).

Sex	ABO				Total
	A	B	AB	O	
Male % within sex	66	20	6	75	167
	39.5%	12%	3.6%	44.9%	100%
Female % within sex	35	19	10	74	138
	25.4%	13.8%	7.2%	53.6%	100%
Total count	101	39	16	149	305
% within sex	33.1%	12.8%	5.2%	48.9%	100%
Statistics	$Chi^2 = 7.861$		$P < 0.05$		

Table 2
Distribution of cases according ABO and Rh blood groups ($n = 305$).

Blood group	Rh		Total
	Rh+ve	Rh−ve	
A % within Rh	92	9	101
	30.2%	3%	33.1%
B % within Rh	30	9	39
	9.8%	3%	12.8%
AB % within Rh	8	8	16
	2.6%	2.6%	5.2%
O % within Rh	136	13	149
	44.6%	4.3%	48.9%
Total count % within Rh	266	39	305
	87.2%	12.8%	100%
Statistics	$Chi^2 = 271.367$	$P < 0.001\%$	

5. Results

5.1. Sex and blood group (Table 1)

In this study males outnumbered females with male to female ratio being 1.2:1. The majority of cases 149 (48.9%) had blood group O; followed by blood group A, B and AB which were 101 (33.1%), 39 (12.8%) and 16 (5.2%) respectively. Chi square test revealed that the relation between sex and blood group is statistically significant as $p < 0.05$.

5.2. ABO and Rh blood groups (Table 2)

266 (87.2%) cases in the study had Rh+ve, 136(44.6%) of them had blood group O. Blood group A, B and AB were 92 (30.2%), 30 (9.8%) and 8 (2.6%) respectively. Most of Rh−ve cases were in blood group O (4.3%). Blood group A and B had the same frequency (3%). By using chi square the distribution of cases according to ABO and Rh blood groups is statistically highly significant as $p < 0.001$.

5.3. Pattern of fingerprints (Table 3)

Loops were the most common pattern registering 50.5%; followed by whorls (35.1%) and arches (14.4%).

5.4. Pattern of fingerprints in different ABO and Rh blood groups (Table 4)

In Rh+ve cases of blood group A and O loops incidences were the highest (52% and 54.3% respectively) then whorls (33.4% and 30.6% respectively). While in Rh−ve cases in blood group A and O whorls (53.3% in blood group A and 50% in blood group O) were higher than loops (46.7% in blood group A and 30% in blood group O). This difference was statistically highly significant by using chi square test as $p < 0.001$. Blood group AB showed highest loops (55% in Rh+ve and 52.5% in Rh−ve) then whorls (32.5% in Rh+ve and 27.5% in Rh−ve) and lastly was arches (12.5% in Rh+ve and 20% in

Table 3
General distributions of primary finger print patterns in all fingers of both hands ($n = 3050$).

Pattern of finger print	Total	Percentage
Arches	440	14.4%
Loops	1539	50.5%
Whorls	1071	35.1%
Total	3050	100%

Table 4
Distribution of pattern of fingerprints among subjects of ABO and Rh blood group ($n = 3050$).

Types of prints	Blood gr. A		Blood gr. B		Blood gr. AB		Blood gr. O	
	Rh+ve	Rh−ve	Rh+ve	Rh−ve	Rh+ve	Rh−ve	Rh+ve	Rh−ve
Arches %within Rh	135	3	40	8	10	16	205	26
	14.7%	4%	13.3%	8.9%	12.5%	20%	15.1%	20%
Loops %within Rh	478	42	119	36	44	42	739	39
	52%	46.7%	39.7%	40%	55%	52.5%	54.3%	30%
Whorls %within Rh	307	48	141	46	26	22	416	65
	33.4%	53.3%	47%	51.1%	32.5%	27.5%	30.6%	50%
Total count %within Rh	920	90	300	90	80	80	1360	130
	100%	100%	100%	100%	100%	100%	100%	100%
Statistics	$Chi^2 = 22.948$		$Chi^2 = 1.357$		$Chi^2 = 1.764$		$Chi^2 = 1.764$	
	$P < 0.001$		$P > 0.05$		$P > 0.05$		$P > 0.05$	

Rh−ve). Frequency of whorls was highest in blood group B in both Rh+ve and Rh−ve subjects; followed by loops then arches. This difference was statistically not significant by using chi square test as $p > 0.05$.

5.5. Pattern of fingerprints in different fingers (Table 5)

In individuals of blood groups A and O, arches and loops were high in their little fingers. In blood group A (A = 14.4% and L = 58.9%) and in blood group O (A = 18.8% and L = 61.1%). Individuals of blood group B showed predominant arches in their little fingers (23.1%) and more loops in their ring fingers (55.1%) and more whorls in their middle fingers (48.7%). Majority of cases of blood group AB had high incidence of whorls (46.9%) followed by arches(21.9%) in their ring fingers but loops showed high frequency in their little fingers (68.8%). The distribution of pattern of fingerprints in different fingers of both hands of subjects was statistically highly significant in blood group A and O by using chi square test as $p < 0.001$, while it was significant in blood group A and AB by using chi square test as $p < 0.05$.

6. Discussion

This study was carried out in 2010 on 305 Libyan medical students of Al-Jabal Al-Gharbi,University, Zawia, Libya. The cases were selected randomly having different ABO blood groups to Study distribution of fingerprint pattern among the subjects having different ABO and Rh blood group and correlate any relation between their characters and blood group.

In this study majority 266 (87.2%) of subjects were Rh positive, studying of them revealed that blood group A and O had highest incidence of loops (52% & 54.3% respectively) followed by whorls (33.4% & 30.6% respectively), while in Rh negative cases incidence of whorls were highest in blood group A & O (53.3% and 50%) respectively followed by loops (46.7% in blood group A and 30% in blood group O). Blood group AB showed highest loops (55% in Rh+ve &52.5% in Rh−ve cases), followed by whorls (32.5% in Rh+ve & 27.5% in Rh−ve) and lastly was arches (12.5% in Rh positive and 20% in Rh negative). Frequency of whorls was highest in blood group B in both Rh+ve and Rh−ve subjects, followed by loops and arches. Hence the present study reveals that there is a significant relationship between distribution of fingerprint pattern and blood groups. The study done by Hane found high frequency of loops with blood group A.[4]

The general distribution pattern of fingerprints showed high frequency of loops (50.5%), moderate whorls (35.1%), and low frequency of arches (14.4%).These results are in accordance with the study done by.[5]

The study also revealed that Rh+ve cases of blood group A, B and O had high frequency of loops, while cases of blood group B (Rh+ve) had high frequency of whorls. This does not coincide with study done in 2004 which reported that Rh+ve and Rh−ve case of all blood groups had high frequency of loops except blood group AB (Rh−ve) that had high frequency of arches.[5]

This study revealed high frequency of loops in thumb, index and little finger of all blood groups. In a similar study done by[5] also found high frequency of loops in middle and little finger. In index finger predominance of whorls was found in blood group AB (52%) and O (39.5%), and predominance of loops in blood group B (35.9%), but blood group A showed same frequency (41%) in both loops and whorls. In our study the middle finger showed increased frequency of loops in blood group A, AB and O (57%, 62.5%, and 56.7% respectively) while whorls were predominant in blood group B (48.7%) in middle finger. Whereas[5] study showed increased frequency of loop (64.1%) in middle finger of all blood groups. Ring finger showed increased frequency of whorls in blood group A and

Table 5
Distribution of pattern of fingerprints in different fingers of both hands of subjects ($n = 305 \times 2$), (A = arches, L = loops, W = whorls).

Individual finger	Blood gr. A ($n = 1010$)			Blood gr. B ($n = 390$)			Blood gr. AB ($n = 160$)			Blood gr. O ($n = 1490$)		
	A	L	W	A	L	W	A	L	W	A	L	W
Thumb	20	95	87	9	42	27	3	20	9	42	140	116
	9.9%	47%	43.1%	11.5%	53.8%	34.6%	9.4%	62.5%	28.1%	14.1%	47%	38.9%
Index	26	92	8	14	33	31	5	14	13	47	132	119
	12.9%	45.5%	41.6%	17.9%	42.3%	39.7%	15.6%	43.8%	40.6%	15.8%	44.3%	39.9%
Middle	27	117	58	3	37	38	6	20	6	52	169	77
	13.4%	57%	28.7%	3.8%	47.4%	48.7%	18.8%	62.5%	18.8%	17.4%	56.7%	25.8%
Ring	27	81	94	10	43	25	7	10	15	37	137	124
	13.4%	40.1%	46.5%	12.8%	55.1%	32.1%	21.9%	31.3%	46.9%	12.4%	46%	41.6%
Little	29	119	54	18	34	26	2	22	8	56	182	60
	14.4%	58.9%	26.7%	23.1%	43.6%	33.3%	6.3%	68.8%	25%	18.8%	61.1%	20.1%
Statistics	$Chi^2 = 30.138$			$Chi^2 = 17.78\%$			$Chi^2 = 14.978$			$Chi^2 = 51.269$		
	$P < 0.001$			$P < 0.05$			$P < 0.05$			$P < 0.001$		

AB (46.5% & 46.9% respectively), while loops were high in blood group B and O (55.1% & 46%). In contrast to this study, Bhardawaj et al., has recorded high frequency of whorls A (61%), B (57.7%), AB (56%) & O (62.6%) in ring finger. Predominance of loops in thumb in all blood groups was recorded in this study as compared to Bhardawaj study which recorded high Loops in all blood groups except AB which showed high frequency of whorls (56%).[5]

7. Conclusion

Study reveals an association between pattern of fingerprint and ABO blood group. With recent advances in fingerprint sensing technology and improvement in the accuracy and matching speed of the fingerprint matching algorithms, automatic personal identification is becoming an attractive/complement to the traditional methods of identification. As biometric technology matures, there will be an increasing interaction among the biometric market and its identification application, since fingerprints will remain an integral part of the preferred biometric based identification solutions in the years to come, a relationship of fingerprint pattern to blood group presents scope for additional identification data which can be used for personal identification purpose, also study of possible predilection of certain disease and malignancies from blood groups are some of the factors which encourages one to carry the study further.

8. Recommendations

Improvements for this study would include increasing the size of sample to get more accurate representation of the population and need for more similar studies in other regions so that comparative study can be done.

Conflict of interest

There is no conflict with anybody.

Funding

None.

Ethical approval

Above mentioned study has been approved by the University Ethical Committee under the No. AJAGU- IEC/2010-11.

References

1. Qureshi MA, Bhatti R. Frequency of ABO blood groups among diabetes mellitus type 2 patients. *J Physicians Surg* 2003;**13**:453–5.
2. Herch M, Papillarmuster BEDLI, Berchungan SP, Bluntgrainppen B. An Liner Dentschem Verglei Chsgrmppe Ztschr Rasseh. *J Physio* 1932;**5**:163–8.
3. Gowda MST, Rao CP. A study to evaluate relationship between dermatoglyphic features and blood groups. *J Anat Soc Ind* 1996;**45**:39.
4. Hahne KW. Die Benfung Der Blugrenppen and Test figures In Vaterschafts Process. Dissertation Bern 1929.
5. Bharadwaja A, Saraswat PK, Agrawal SK, Banerji P, Bharadwaj S. Pattern of fingerprints in different ABO blood groups. *J Forensic Med Tox* 2004;**21**(2): 49–52.
6. Wertheim K, Maceo A. The critical stage of friction ridge and pattern formation. *J Forensic Identification* 2002;**52**(1):35–85.
7. Anil J. Fingerprint classification and matching. Dept.of Computer science & Engg., Michigan State University, East Lansing.
8. Herschel WJ. Wahul. *Skin furrows of the hand* 1880;vol. 23. p. 76.
9. Galton F. *Finger prints*. London: Macmillan and Co; 1892.
10. Cummins H, Palmer P. Epidermal ridge configuration (Dermatoglyphics) in Europeans and Americans. *Am J Phy Anthrop* 1926;**179**:741–802.
11. Lee HC, Gaensslen RE. *Advances in fingerprint technology*. New York: Elsevier; 1991.